APPENDIX 39

Field Notes

A Closer Look at Imperviousness Increases by State

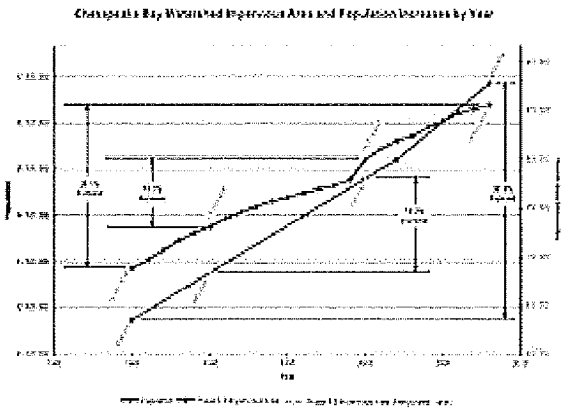
Vol. 18 No. 4 March 31, 2010

Wetland Studies and Solutions, Inc. (WSSI) analyzed the imperviousness and population increases in each state between 1990 and 2000. The results are shown below:

Jurisdiction (Portion within the Chesapeake Bay Watershed)	Population Increase (1990-2000) (%)	Impervious Area Increase (1990-2000) (%)	Ratio (Impervious Area Increase / Population Increase)
Chesapeake Bay Watershed	10.3%	14.2%	1.4
Delaware	23.2%	28.4%	1.2
District of Columbia	-5.7%	1.9%	N/A
Maryland	10.7%	15.2%	1.4
New York	-2.2%	3.7%	N/A
Pennsylvania	5.4%	10.6%	2.0
Virginia	16.8%	18.0%	1.1
West Virginia	18.0%	21.0%	1.2

Population and area increases between 1990 and 2000 (based on a linear interpolation of the Phase 5.2 Chesapeake Bay Model results).

Graphical views of WSSI's analysis are available by clicking on the image below:



WSSI's study of the individual states' increases indicates that Maryland, typically touted as the "Smart Growth" state that others should emulate, had a higher ratio of impervious increase to population increase (1.4-to-1) than Virginia (1.1-to-1), which is typically considered to be a sprawling state. This leads into another discussion that is led by emotion rather than logic, which we also discuss in this newsletter, of whether high-density or low-density development is better for the Bay. (See "Development Density's Effect on Imperviousness Increase.")

Of the states that had positive growth, Pennsylvania had the highest ratio at approximately 2-to-1. (Note that this is still far below the 5-to-1 ratio from the original claim.) The District of Columbia and New York state each saw a slight increase in impervious area while also seeing their population drop by up to 6%.

WSSI conducted similar analyses for 26 local jurisdictions in the Chesapeake Bay watershed to discern any ratio trends based on high growth versus low growth jurisdictions and rural versus urban jurisdictions. Our results follow:

- Albemarle County, Virginia;
- City of Alexandria, Virginia;
- Allegany County, Maryland;
- Anne Arundel County, Maryland;
- Arlington County, Virginia;
- Baltimore County, Maryland;
- City of Charlottesville, Virginia;
- Charles City County, Virginia;
- Chesterfield County, Virginia;
- Fairfax County, Virginia;
- Fauquier County, Virginia;
- Frederick County, Maryland;
- City of Hampton, Virginia;
- Hanover County, Virginia;
- Henrico County, Virginia;
- James City County, Virginia;

- Loudoun County, Virginia;
- Montgomery County, Virginia;
- City of Newport News, Virginia;
- Northumberland County, Virginia;
- Prince George's County, Maryland;
- Prince William County, Virginia;
- City of Richmond, Virginia;
- Stafford County, Virginia;
- Westmoreland County, Virginia; and
- City of Williamsburg, Virginia.

This type of information should be very useful to urban planners and elected officials. If planners can determine the key public policy decisions that have led to these varying ratios of impervious area growth versus population growth, techniques that have worked to achieve lower ratios in certain jurisdictions may be more widely implemented throughout the watershed to keep the ratios low region-wide.

Wetland Studies and Solutions, Inc.®

5300 Wellington Branch Drive • Suite 100 • Gainesville, VA 20155
Tel.703.679.5600 • Fax.703.679.5601 • contactus@wetlandstudies.com

Field Notes Wetland

Does the Model Provide a Good Estimate of Impervious Area?

Vol. 18 No. 4 March 31, 2010

One argument against using the impervious area from the Chesapeake Bay Model is the assertion that the purpose of the Model is to estimate pollutant loads, and that it was not intended to estimate impervious area. However, based on the U.S. Environmental Protection Agency's own documentation for nutrients and sediment, the calculated pollutant loads from impervious areas are directly related to impervious area. Therefore, if we are to believe that the estimated pollutant loads are accurate (which we do), we must also acknowledge that the impervious areas are accurate.

Sediment Load Estimates

In the Phase 5.2 Model, urban land use sediment comes from two sources: pervious/impervious developed land and bare construction. For each of these sources, sediment load is directly related to impervious area.

Developed Land

The sediment load from pervious/impervious developed land is derived from a direct relationship between imperviousness and sedimentation rates. Section 9.2.6 of the Model documentation[1] states that, "*...we form a relationship between the degree of imperviousness and an associated sediment load (Figure 9.2.6.1).*" Since the sediment is based on a linear relationship, the impervious area must be correct for the sediment load to be correct. (Click on the graph below for a larger view.)

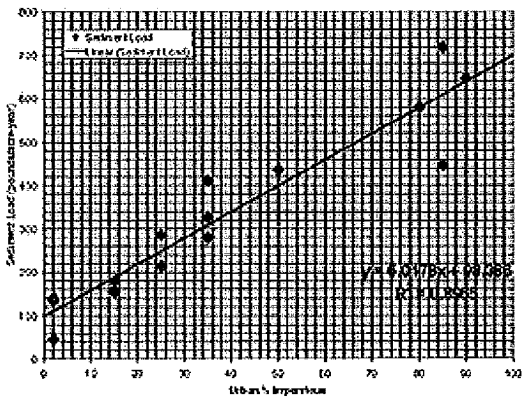


Figure 9.2.6.1 - Relationship of Sediment Loads to Degree of Developed Imperviousness. (Source: Langland and Cronin, 2003).

Construction

Sediment from construction is also derived directly from the yearly change in impervious area, according to Section 9.2.7 of the Model documentation. Section 9.2.7 states that, "*Land area estimates of the bare-construction land use are based on the assumption that the bare construction area is equivalent to 2.5 times the annual change in imperviousness (as described in Section 4).*" The section further goes on to say, "*Combining the estimated portion of the ground disturbed and the estimated time of the disturbance gives us a rate of 24.4 tons/acre-year for construction areas prior to implementation of erosion and sediment (E&S) controls.*" In this Model, the sediment load is a direct multiplier of the bare construction area, and the bare construction area is a direct multiplier of the yearly change in impervious area. Therefore, the sediment load is directly proportional to the yearly change in impervious area.

Nutrient Load Estimates

Section 10.2.16 of the Model documentation indicates that, "*a standard practice for estimating nutrient loads from developed land is the Simple Method, in which the annual nutrient load is determined by the annual runoff multiplied by the median event mean concentration (EMC) (Schueler, 1987: Pitt et al., 2004).*" It also states that the total phosphorus (TP) loading rate is "*2.1 lb/ac/yr for impervious developed land.*"

For total nitrogen (TN), the loading rate is "*11.8 lb.ac.yr for impervious developed* [land]."

This alone indicates that the Phase 5 nutrient calculations are based directly on impervious area and that ***both*** imperviousness estimates and loading estimates must be correct if either is correct. Furthermore, the same section states that, "*the Phase 5 simulation uses this information to advantage through* ***the fine resolution of imperviousness associated with each Phase 5 land-river-segment.***"

[1] U.S. EPA, 2009. *Chesapeake Bay Phase 5 Community Watershed Model* **In preparation** EPA XXX-X-XX-008 Chesapeake Bay Program Office, Annapolis MD. January 2009.

5300 Wellington Branch Drive • Suite 100 • Gainesville, VA 20155
Tel.703.679.5600 • Fax.703.679.5601 • contactus@wetlandstudies.com

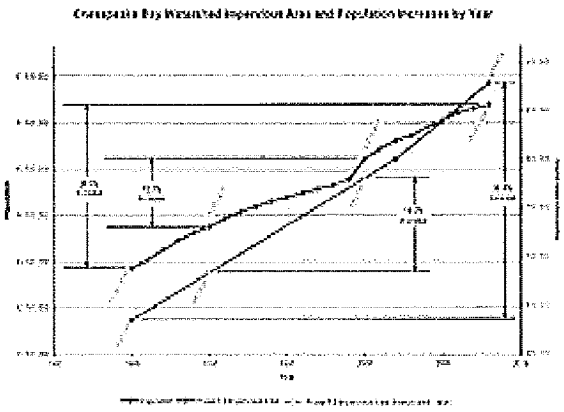
Field Notes

The Case for a 14% Increase in Impervious Area from 1990 to 2000

Vol. 18 No. 4 March 31, 2010

The U.S. Environmental Protection Agency (EPA) developed the Chesapeake Bay Community Watershed Model (Phase 5.2 is currently available to the public; Phase 5.3 is expected within the next month) to determine the current and allowable pollutant (phosphorus, nitrogen, and sediment) loads in the Chesapeake Bay. The Phase 5 Model documentation indicates that nitrogen and phosphorus pollutants from impervious surfaces are simulated by multiplying a loading rate times the impervious area; therefore, the Model directly calculates the pollutant load based on the area of the impervious surface. If we believe that the modeled pollutant loads are correct based on the science and calibration that have gone into the Model, which we do, we must also believe that the Model accurately represents the impervious area.

Fortunately, the Phase 5.2 Model results' spreadsheet provides the area breakdown by source sector, in addition to providing the pollutant loads. This data indicates that between 1985 and 2008 (the full simulation period), the urban impervious area increased by 38.4%. Interpolation of the Model's output data shows that the urban impervious area increased by 14.2% between 1990 and 2000, as shown in the graph below (click on the graphic for a larger view).



One argument made against our analysis is that, since the model only predicts imperviousness in "urban" areas, it misses any impervious increase in more rural locations, and this could account for the discrepancy between the original claim and Wetland Studies and Solutions, Inc.'s (WSSI's) analysis. This assertion is simply not true.

If the discrepancy was explained by growth in rural and agricultural areas, that growth would need to account for approximately 148,800 acres of new impervious surface, one and one-half times as much growth as was simulated in urban areas (97,150 acres) - an unlikely scenario. Furthermore, we must look at what EPA defines as "urban." WSSI's GIS Department overlaid EPA's "urban lands" data layer[1] on an area that would typically be defined as rural to determine where rural land uses end and urban land uses begin. The image below (click on the image below for a larger view) shows the town of Catlett, in Fauquier, Virginia (population: 3,615 within 66 square miles and 109 within the town proper). While most people would describe Catlett as rural, it falls within the "urban" land use category, as does the two-lane section of Route 28 leading into and out of town through agricultural fields. This example indicates that the likelihood of adding nearly 150,000 acres outside of "urban" land uses is very low indeed. It also indicates urban areas in fields under corn/soybean rotation and pastures – including one we converted into wetlands. Thus, it is not realistic to assume that the bulk of the 41% increase in impervious area, postulated by EPA, occurred in such rural areas.

[1] 2000 Land Use layers accessed from ftp://ftp.chesapeakebay.net/Modeling/GIS/landuse/p5_urb00lc_2 (last accessed 3/11/2010).

Wetland Studies and Solutions, Inc.

5300 Wellington Branch Drive • Suite 100 • Gainesville, VA 20155
Tel.703.679.5600 • Fax.703.679.5601 • contactus@wetlandstudies.com

Field Notes

Calculating the Population Change

Vol. 18 No. 4 March 31, 2010

Wetland Studies and Solutions, Inc.'s GIS Department overlaid the relevant U.S. Census data tracts on a map of the Chesapeake Bay watershed and removed any area (of each county) that fell outside of the watershed. This analysis showed that approximately:

- 14,250,000 people lived in the watershed in 1990; and
- 15,715,500 people lived in the watershed in 2000.

This equates to a 10.3% increase during the 1990-2000 period. The revised increase is 2.3 percentage points higher than the U.S. Environmental Protection Agency (EPA) statements (10.3% rather than 8%). This is a significant 30% difference, which EPA learned about in 2009[1] and which should have been reflected in public documents at that time. In fact a year later, EPA officials were still using the 8% population increase in Total Maximum Daily Load (TMDL) briefings and updates to elected officials, such as a joint session of the Virginia House and Senate committees dealing with the Chesapeake Bay.

We appreciate the fact that after our notification, the EPA has changed their Web site to 10% from 8%, though we have since requested that this percentage be further revised to reflect 10.3%.

[1] Based on documentation downloaded from the EPA Web site (which was last accessed on February 19, 2010), EPA recalculated the population increase on or before February 2, 2009.

Wetland Studies and Solutions, Inc.

5300 Wellington Branch Drive • Suite 100 • Gainesville, VA 20155
Tel.703.679.5600 • Fax.703.679.5601 • contactus@wetlandstudies.com

Field Notes

The Great Debate: Imperviousness Growth and Population Growth

Vol. 18 No. 4 March 31, 2010

The U.S. Environmental Protection Agency's (EPA's) Chesapeake Bay Program developed and published a widely-cited sound bite:

> *"From 1990 to 2000, impervious surfaces increased by 41% - a rate 5 times greater than the 8% rate of population growth during that time."*

This ratio of impervious area growth to population growth is being used as a justification for significant public policy changes in stormwater management policy throughout the Chesapeake Bay watershed. While we agree that regulatory improvements in stormwater policy are necessary to protect the aquatic environment (as illustrated by our office's EPA award-winning example of Low Impact Development), public policy must ultimately be based upon sound science, which we do not believe is the case with the sound bite above.

The issue centers on the fact that U.S. Census data and EPA's Phase 5.2 Cheasapeake Bay Community Watershed Model (the "Model") indicate that this sound bite should actually be:

> *"From 1990 to 2000, impervious surfaces increased by **14.2%** - a rate **1.4** times greater than the **10.3%** rate of population growth during that time."*

Alternatively, to be consistent with the Phase 5.2 Model timeframe, perhaps a better statement (until the 5.3 Model is released), would be:

> *"From 1985 to 2008, impervious surfaces increased by 38.4% - a rate 1.4 times greater than the 26.5% rate of population growth during that time."*

Wetland Studies and Solutions, Inc. provided an analysis to support these proposed revisions to EPA in a report on February 23, 2010. Since then, we have had productive and responsive communications (via e-mail and telephone) and a face-to-face meeting with EPA officials to discuss our findings. EPA has agreed with our assessment of population growth and has not identified any inaccuracies

in our numeric computations regarding the growth of impervious area. However, the EPA does not agree with using the results from its Model (which is being used to drive the Total Maximum Daily Load (TMDL) process for the Chesapeake Bay) to determine impervious area estimates because the Model was developed to estimate pollutant loadings. We respectfully disagree with this conclusion for many reasons – chief of which is the fact that the Model's documentation specifically contains well-accepted direct relationships between impervious area and non-point source pollutants from urban areas. Therefore, if the Model's estimates of impervious area are incorrect, then the resultant pollutant loadings are also incorrect.

Our reports and findings are cited below:

1. *An Analysis of Impervious Area Increase vs. Population Growth in the Chesapeake Bay Watershed Between 1990 and 2000* (dated February 23, 2010); and
2. *An Analysis of Impervious Area Increase vs. Population Growth in the Chesapeake Bay Watershed Between 1990 and 2000 – Addendum #1* (dated March 9, 2010).

We also transmitted several e-mails and memos to EPA during our dialogue, which have been incorporated into this edition of *Field Notes*.

It is also important to note that EPA provided us with a draft response for discussion purposes and a final response to our analysis (after we met on March 12, 2010) via e-mail on March 14, 2010. However, we felt that they had not fully considered the available information, and we offered to embargo that response in order to provide the EPA with more time to finalize their position. Originally, this was expected to take another week or so – but after 2-1/2 weeks, we were informed that a response date is still uncertain as it needs approval of both the EPA Region 3 Administrator and the Administrator of EPA. Thus, with the consent of EPA, we are publishing this newsletter with their current response and we agree to immediately publish their next response as soon as it is ready. It is our understanding that the EPA will likely continue to agree with our population growth estimate and propose a new impervious area growth estimate that is somewhere between their 41% estimate and the 5.2 Model data of 14.2% - and utilize a longer timeframe than the 1990-2000 era.

While we still have not reached a consensus opinion on this issue, EPA's willingness to work with us on this issue (by correcting their population data analysis and revising their impervious area growth statements) is greatly appreciated and respected.

The difference in professional opinion is very simple. We believe that if the EPA Phase 5.2 Chesapeake Bay Watershed Model is accurate, then EPA should state that the rate of impervious area growth to population growth is 1.4, not 5. The only other alternative is to conclude that this Model is not in the ballpark of acceptable accuracy.

The issues presented in our report and EPA's response are explored in the series of articles contained in this issue of *Field Notes* so that readers can make their own informed opinion.

Questions can be addressed to Mike Rolband or Jennifer Brophy-Price.

Wetland Studies and Solutions, Inc.®

5300 Wellington Branch Drive • Suite 100 • Gainesville, VA 20155
Tel.703.679.5600 • Fax.703.679.5601 • contactus@wetlandstudies.com

Field Notes

Follow Up on the Debate Over Impervious Area and Population Growth in the Chesapeake Bay Watershed

Vol. 18 No. 5 May 3, 2010

Wetland Studies and Solutions, Inc. (WSSI) recently analyzed[1] (see *Field Notes* Vol. 18 No. 4)the following widely-cited sound bite from the U.S. Environmental Protection Agency's (EPA's) Chesapeake Bay Program:

> *"From 1990 to 2000, impervious surfaces increased by 41% - a rate 5 times greater than the 8% rate of population growth during that time."*

We concluded that the above statement did not agree with U.S. Census data from that time period nor the Phase 5.2 Chesapeake Bay model, which was the most advanced model available to us at the time.

EPA has not responded directly to us regarding our newsletter or analysis, even though we have been in direct discussion with them for the past two months and have been told on several occasions that a response would be forthcoming after being reviewed by successively higher authorities within EPA. However, this past week, the attached "response memo" was forwarded to us by several parties outside of EPA, including Congressman Gerry Connolly, who had requested that EPA clarify their position on the rate of impervious area increase.

We would like to take this opportunity to respond to EPA's letter to Congressman Connolly, EPA's response memo, and "Attachment C, Proposed Changes to the Phase 5.3 Land Use Dataset," from the April 19, 2010 conference call of the Chesapeake Bay Program's Water Quality Goal Implementation Team.

The Bottom Line

1. EPA agrees with us that their original population data was wrong and has revised their Web site to reflect the new data.

2. EPA proposes a new method to estimate impervious surface change, which results in a rate of impervious surface growth that is different from any of the rates discussed previously in this debate but is closer to the modeled rate of change than the sound bite rate.

3. Even though EPA has proposed a new method for estimating impervious area change, their Web site[2] still states,"Between 1990 and 2000, impervious cover increased by

nearly 250,000 acres—about 41 percent, or the size of five District of Columbias."

Conflicting Statements and the Raw Data

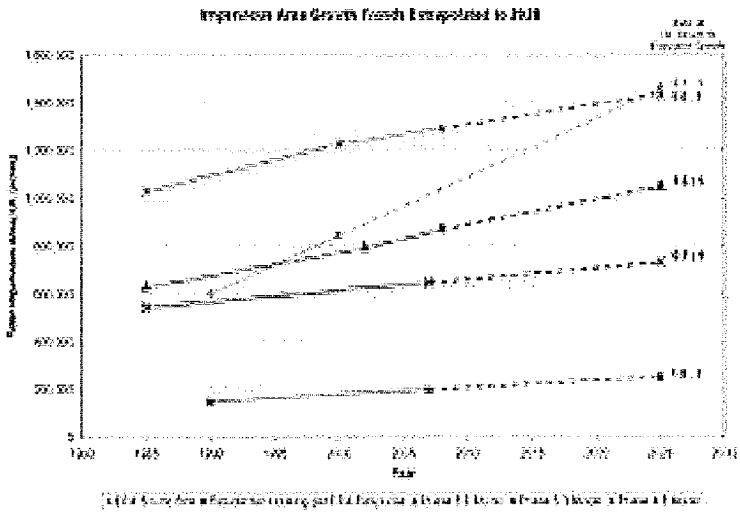
The most interesting element of EPA's response may be that the April 19, 2010 response memo and the document titled, "Attachment C," (which was distributed at the April 19, 2010 meeting of the EPA Chesapeake Bay Program's Water Quality Goal Implementation Team) directly conflict. Attachment C states that, "the rate of impervious surface change will increase over the current rate in Phase 5.3 but may not be as high as the rate of change in Phase 5.2,"[3] while the response memo estimates a rate of change higher than that seen in the Phase 5.2 model, as shown in the following table:

Source	Time Period	Impervious Surface Growth	Population Growth	Ratio of Impervious Surface Growth to Population Growth
EPA Sound Bite	1990-2000	41.0%	8.0%	5.1 : 1
EPA Response Memo	1990-2007	34.0%	18.0%	1.9 : 1
Phase 4.3 Model	1985-2008	26.3%	26.5%	1.0 : 1
Phase 5.2 Model	1985-2008	38.4%	26.5%	1.5 : 1
Phase 5.3 Model	1985-2007	19.2%	26.5%	0.7 : 1

To put these numbers on equal footing with the original debate, we have also provided the table below, which reflects the 1990-2000 time period initially discussed:

Source	Time Period	Impervious Surface Growth	Population Growth	Ratio of Impervious Surface Growth to Population Growth
EPA Sound Bite	1990-2000	41.0%	8.0%	5.1 : 1
EPA Response Memo		18.0%[4]	10.3%	1.7 : 1
Phase 4.3 Model		11.9%	10.3%	1.2 : 1
Phase 5.2 Model		14.2%	10.3%	1.4 : 1
Phase 5.3 Model		8.4%	10.3%	0.8 : 1

We have also provided a chart below (click for full size), in an attempt to correlate EPA's impervious surface data. We have graphed the existing data and extrapolated that data to the year 2025 to show how the trends impact future impervious surface predictions.



The tables and chart above succinctly show that, while EPA states that they do not agree with our original issue (that the 5:1 ratio used in the talking point is not correct), all of their recent data and proposals result in **imperviousness-to-population-growth ratios ranging from 0.7:1 to 1.9:1**, less than half of the increase indicated by their original talking point. As engineers and scientists, we can only conclude that EPA's own information does in fact agree with ours and that the 5:1 sound bite is incorrect.

Another item of note regarding the chart above is that the raw impervious surface data varies widely between the three models and the original 41% growth claim. The Phase 4.3 model data is substantially higher than the other two models, but even between the two Phase 5 models, the 2007-2008 data varies by slightly more than one third. This yields 2025 projections that differ by 44% between the Phase 5.2 and 5.3 models. (The original sound bite projection is 38% higher than the Phase 5.2 projection and 99% higher than the Phase 5.3 projection.)

Muddying the Issue

EPA sent a letter to Congressman Gerry Connolly in response to a request by Congressman Connolly's office for EPA to clarify their position on the rate of impervious area increase. EPA's April 21, 2010 response to Congressman Connolly states:

> *"...we do not agree with the conclusions of the stakeholders mentioned in your letter. What is most important to this issue is that the amount of impervious surfaces in the Chesapeake Bay watershed continues to increase and is increasing at a rate faster than population growth."*

This response perplexes us for several reasons:

First, EPA's response throws the discussion off topic. Rather than responding with their

reasons for disagreeing with WSSI's position or even discussing what our original position was, EPA obfuscates the matter by generally discussing "what is most important to this issue."

Second, EPA states that, "we do not agree with the conclusions of the stakeholders." However, our original position on this issue based on the Phase 5.2 model, and the position that we still hold, is that:

- Impervious surface is increasing;
- Impervious surface is increasing faster than population growth;
- Impervious surface did not increase 41% between 1990 and 2000 (based on the best available science, which we believed was the Chesapeake Bay model, we suggested that the 41% statistic be changed to 14.2%, a *rate 1.4 times faster than the 10.3% rate of population growth*); and
- The modeled rate of impervious surface change should match the real-world rate of change, and both of those rates should match any sound bites used by EPA and others when discussing this issue. Since the impervious area is directly linked to pollutant runoff in the model, the rate of change is critical to future loading projections. The rate of change determines the future amounts of impervious area, and the future amounts of impervious area determine the future pollutant loadings.

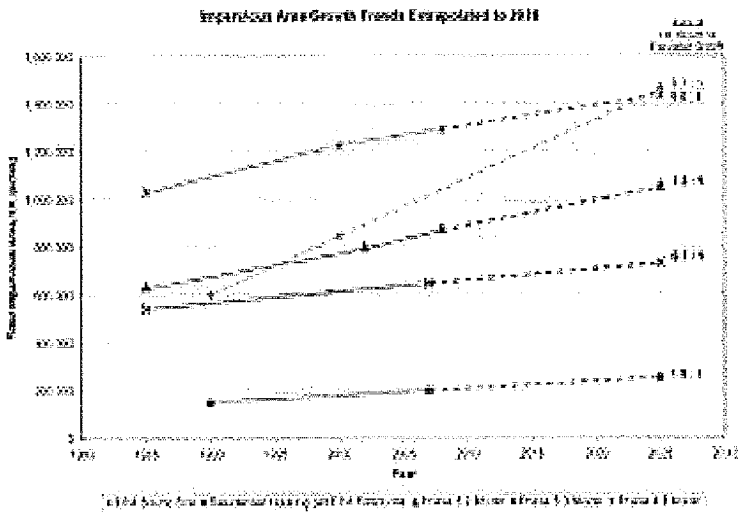
Therefore, it bewilders us that EPA claims to not agree with our position in the cover letter while at the same time providing a new metric for determining the imperviousness growth within the memo itself, which proposes a rate of imperviousness increase markedly different than any of their Bay models.

Economic Trends

In the attached memo's 6th paragraph, EPA states that the 41% growth rate between 1990 and 2000 "may not have continued with the more recent economic downturn." This statement ignores the fact that there was a major economic recession in the early 1990s and is, therefore, simply a statement without basis.

The Distinction between "Rate" and "Amount...Each Year"

In the memo's 7th paragraph, EPA states, "finally, for protecting and restoring water quality, the most important variable is not the *rate* at which impervious surface is growing, but rather the additional *amount* of impervious surfaces added each year." In this statement, the phrases "*amount* of impervious surfaces added each year" and "*rate* at which impervious surface is growing" should have the same meaning since the term "rate" denotes a change per unit time. (Mathematically, the existing amount of impervious surface this year multiplied by the rate the surface is growing equals the additional amount of impervious surface the next year.) EPA's desired distinction between the two is unclear; they appear to be providing two definitions that both address the same process. Even if a distinction is made between rate and amount added per year, we would submit that the rate of impervious area change is critical to modeling future projections. Since the simulated pollutant loadings from urban areas are *directly proportional* to the amount of impervious surface at any point in time, we need to know the rate at which impervious surface is increasing to properly estimate future impervious areas and pollutant loads, as shown in the graph below:



Source Citations

The memo contains no source citations for numerical assertions, which makes review of EPA's new proposed sound bite impossible. For instance, in the memo's only graph, no citation is made regarding:

- "Single-family house floor area (sq. feet);"
- "Estimated increase in single-detached housing units;"
- "Single-family house size in the northeastern U.S. in year i;"
- "Single-family residential units permitted in year i;" and
- "Ratio of change in single detached housing units (1990-2000) to change in single-family residential unit permits (1990-2000)."

This makes it impossible to verify the claim made by EPA regarding single-family housing trends. For instance, "single-family house size" could denote either the house footprint or the livable area; in reality, there will be a ratio of "impervious footprint increase to living area increase," but the graph and memo do not appear to address this.

Given that EPA appears to want to use this housing growth statistic as the new "impervious area" sound bite even while acknowledging that it is not a good estimate of overall impervious area increase, we believe that it should at least be well-cited.

In fact, the only references cited in the memo have nothing to do with the increase in impervious area, which is arguably the focus of the memo. Rather, the four references discuss the relationship of stream flow to imperviousness; soil disturbance during construction; soil compaction; and general impervious cover. These items are not in question and were not the central focus of the memo. Therefore, the fact that they are the only references cited in the memo indicates to us that EPA is trying to continue making an emotional argument against development rather than a rational argument about how to

improve water quality in the Bay.

Conclusion

We would like to state again that our assertion on this matter is not meant to impugn the Chesapeake Bay Program or the Bay cleanup efforts. We acknowledge that, in all likelihood, impervious surfaces in the Bay watershed are indeed growing more quickly than population. We also firmly believe that both stronger stormwater management measures and retrofits of existing impervious surfaces must be implemented by developers, public works, agencies, property owners, and residents if we are going to Save the Bay in our lifetimes. Cartoonist Walt Kelly, on Earth Day 1970 (and 1971), summed up the true issue succinctly:

We also, however, believe that the 41% sound bite is wrong and that it is being used not because it is based on scientific fact but because a high imperviousness growth rate is a quick and easy way to appeal to the public's emotions.

For more information, please contact Mike Rolband, Jennifer Brophy-Price, or Bethany Bezak.

[1] - An Analysis of Impervious Area Increase vs. Population Growth in the Chesapeake Bay Watershed Between 1990 and 2000, February 23, 2010
- An Analysis of Impervious Area Increase vs. Population Growth in the Chesapeake Bay Watershed Between 1990 and 2000 - Addendum #1, March 9, 2010
- *Field Notes* Vol. 18 No. 4 - The Debate on Impervious Area and Population Growth in the Chesapeake Bay Watershed

[2] http://www.chesapeakebay.net/imperviousurfaces.aspx?menuitem=14670 (Last accessed April 26, 2010)

[3] Page 2, section titled, "Probable effect of these changes on the Phase 5.3 land use dataset," number 5

[4] Because EPA did not provide raw data with their chart of single-family house trends, this number is

estimated from the graph's secondary axis showing cumulative square footage.

Wetland Studies and Solutions, Inc.®

5300 Wellington Branch Drive • Suite 100 • Gainesville, VA 20155
Tel.703.679.5600 • Fax.703.679.5601 • contactus@wetlandstudies.com

Field Notes

Impervious Area and Population Growth Estimates Change Again

Vol. 18 No. 6 June 3, 2010

In previous articles (see *Field Notes* Vol. 18 No. 4 and Vol. 18 No. 5), Wetland Studies and Solutions, Inc. (WSSI) examined the statement:

> *"From 1990 to 2000, impervious surfaces increased by 41% - a rate 5 times greater than the 8% rate of population growth during that time."*

Since then, there has been much discussion about this topic causing the U.S. Environmental Protection Agency (EPA) to re-examine its land use estimates. The result is a new draft land use dataset[1] that shows:

> From 1984 to 2006, impervious surfaces increased by 30% - a rate slightly higher than the estimated 26% rate of population growth during that time.

Recently the EPA has begun creating a new urban land use dataset (the "Phase 5.3mod dataset") to refine the acres of extractive land uses, low-density residential development, roads, and rural residential lots in the Phase 5.3 Model. On June 2, 2010, EPA provided WSSI (via e-mail) a memo titled, "Phase 5.3 (modified) 'Developed' and 'Extractive' Land Use Datasets" (the "5/25 Memo"), dated 5/25/10. The 5/25 Memo describes the need for EPA to analyze the Phase 5.3 Model numbers and outlines the methods used to create the modified Phase 5.3 urban land use dataset. This historical estimate of developed land use is termed by EPA the ***"plausible extreme estimate of urban land extent for developing a margin of safety for the TMDL[2]."*** EPA also provided WSSI (on June 3, 2010) an updated Phase 5.3mod dataset spreadsheet[3].

Impervious Area and Population Growth Update

WSSI analyzed the impervious area growth (from the Phase 5.3mod dataset) and population growth rate (from U.S. Census data) for the Chesapeake Bay Watershed to understand the ratio between these values. The results are shown below:

Population Growth[4] (Percent Increase)		Total Impervious Growth[5] (Percent Increase)		Ratio
1984 to 1992	10.06%	1984 to 1992	12.96%	1.3:1

1992 to 2001	9.34%	1992 to 2001	9.97%	1.1:1
2001 to 2006	4.90%	2001 to 2006	4.74%	1.0:1
1984 to 2006	**26.24%**	**1984 to 2006**	**30.12%**	**1.1:1**

Based on the most recent Phase 5.3mod dataset, impervious area growth is slightly higher than population growth; however, it is still lower than the original 5:1 impervious growth to population growth ratio (estimated prior to EPA updating the population change estimate between 1990 and 2000).

Total Maximum Daily Load (TMDL) Model Effect

In the 5/25 Memo, the EPA provided the following table comparing the acres of impervious and pervious surface in the Chesapeake Bay Watershed for the Phase 5.2, 5.3, and 5.3mod Models.

Model Version	Analysis Year	Impervious Surface (ac)	Pervious Surface (ac)
Phase 5.2	2002	799,989	3,591,799
Phase 5.3	2002	675,917	1,885,935
Phase 5.3mod	2001	1,587,575	5,896,707
Phase 5.3mod (excluding suburb and rural wooded areas)	2001	1,569,377	3,442,346

This table shows a large increase in the total acres of impervious and pervious surfaces from a previous version of the Model. Since prior phases of the Model were calibrated against real-world data (i.e., mass pollutant loads), the Model must be a zero-sum game in which the total load from all sources above any monitoring station must remain relatively constant.

Effect on Pollutant Loading Rates

The initial loading rates for urban areas are based on concentrations from Phase I stormwater data and the simulated hydrology. The calibrated rate is adjusted along with other land uses to meet local water quality monitoring. Since an increase in urban land area and a decrease in forest area will lead to a higher initial total load, it is likely that the calibrated rates for all land uses will decrease slightly in many areas on a pound per acre basis. The increase in acres for urban land areas will likely lead to an overall increase in the total loads from urban land use areas. Throughout the calibration process, the relative loading rates between land uses in a local area will maintain a constant ratio.

Conclusion

WSSI recommends that the EPA take the following steps to create the most accurate TMDL model possible and ensure that the resulting Watershed Improvement Planss are fair and equitable:

1. Take the time necessary time (understanding that the Chesapeake Bay

Foundation would have to agree to such an extension due to its recent lawsuit settlement) to verify the accuracy of the Model - which we understand would be two to four months. This should be accomplished through ground truthing (on the ground surveys or high resolution aerial imagery) in a statistically valid manner and an independent, third party review of the new methods and resulting data.

2. Prepare the TMDL based on the most accurate land use data currently available. The public is better served if regulations are developed using corrected land use data versus rushing now to use a model with land use data that is significantly different than more recent estimates.

For more information, please contact Mike Rolband, Jennifer Brophy-Price, or Bethany Bezak.

[1] Estimated from spreadsheet "Phase5.3mod_LandUse_Statistics_excl_wooded.xls," which was received 6/3/2010 via e-mail from Peter Claggett to Mike Rolband.
[2] E-mail received 5/24/2010 from Peter Claggett to Mike Rolband: "Please note that this dataset is only being used by EPA to represent a plausible extreme estimate of urban land extent for developing a margin of safety for the TMDL (Total Maximum Daily Load).
[3] "Phase5.3mod_LandUse_Statistics_excl_wooded.xls," which was received 6/3/2010 via e-mail from Peter Claggett to Mike Rolband.
[4] Based on U.S. Census estimates.
[5] Estimated from spreadsheet "Phase5.3mod_LandUse_Statistics_excl_wooded.xls," which was received 6/3/2010 via e-mail from Peter Claggett to Mike Rolband.

Wetland Studies and Solutions, Inc.®

5300 Wellington Branch Drive • Suite 100 • Gainesville, VA 20155
Tel.703.679.5600 • Fax.703.679.5601 • contactus@wetlandstudies.com